

A REVIEW OF THE AMERICAN SPECIES OF BELONIDÆ.

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In the present paper we have attempted to give the synonymy of the American species of Needle-fishes or *Belonidæ*, together with analytical keys by which the genera and species may be distinguished.

The American species have been, until lately, all referred to the genus *Belone*. The type of the latter genus, *Esox belone* L., has, however, well-developed gill-rakers, while, in all the American species thus far examined, these appendages are wholly absent. This character seems to be of sufficient importance to necessitate the separation of these species from *Belone*, and other less important differences make still further subdivision convenient.

The genera of *Belonidæ* recognized by us may be thus compared :

ANALYSIS OF GENERA OF BELONIDÆ.

- a. Gill-rakers well developed, slender, and moderately numerous; vomer sometimes with teeth; body subterete or moderately compressed; dorsal and anal falcate BELONE, 1.
- aa. Gill-rakers obsolete; vomer toothless.
 - b. Anterior dorsal rays prolonged, forming a lobe which is more or less falcate; caudal fin lunate or emarginate, the lower lobe more or less produced. TYLOSURUS, 2.
 - bb. Anterior dorsal rays not prolonged, not forming a lobe; caudal convex; body not compressed, nearly as broad as deep; the caudal peduncle slender. POTAMORRHAPHIS, 3.

Genus I. BELONE.

MASTACEMBELUS, Klein, Pisc. Missus., iv, 17 (pre-Linnæan).

ESOX sp. Linnaeus, and of early writers. (Not type.)

ESOX Rafinesque,* Caratteri di Alcuni nuovi Genera, 1810; 59 (restricted to *Esox belone*).

RAMPHISTOMA Rafinesque (MSS.?); Swainson, Nat. Hist. Class'n Anim., ii, 1839, 296 (*vulgaris*=*belone*).

MACROGNATHUS Gronow, Systema, Ed. Gray, 1854, 147 (*scolopax*=*belone*).

MASTACEMBELUS Bleeker, Nederl. Tijdskr. Dierk., iii (*belone*: after Klein).

* Rafinesque observes:

“Il genere *Esox* di Linneo è stato diviso da Lacépède in quattro generi, *Esox*, *Sphyrena*, *Synodus* e *Lepisosteus*; io propongo di dividere nuovamente in due il suo genere *Esox*; lascerò questo nome alle specie marine che hanno il corpo tetragono con due linee laterali da ogni lato come nel genere *Exocoetus*, le mascelle lunghe e strette, le ale dorsale lunghe giungendo dall'ano fino alla coda e falciformi, &c.; mentre formerò un nuovo genere col nome di *Lucius* della specie fluviatile che hanno il corpo cilindrico, una sola linea laterale, le mascelle larghe, e le ale dorsali ed anali corte e rotondate.”

This genus is well distinguished from the others in this group by the presence of gill-rakers. We are not sure as to the number of species which it may contain. The presence of gill-rakers has been verified by us only in *Belone belone* L. (= *vulgaris* Cuvier) and in *Belone platyura* Bennett. Dr. Vinciguerra informs us that gill-rakers occur in *Belone acus* Risso also, but the latter nominal species is regarded by Steindachner as based only on specimens of *B. belone* in which the vomerine teeth are abnormally undeveloped. In all the other species which we have seen gill-rakers are absent.

The question as to the name which this genus should retain offers some difficulty. The first definite restriction of the composite Linnæan genus *Esox* is that of Rafinesque, who retains as the type *Esox belone*. It is equally certain, however, that if we could question Linnæus as to his intended type (as some ornithologists have proposed to do) the species selected by him would be *Esox lucius*. Artedi first used the name *Esox* in a generic sense, and at first only *E. lucius* was included by him in it. The name of *Esox* was taken by Artedi from Pliny, and the *Esox* of Pliny was regarded by Artedi as being the common pike.

Besides the differences in the development of the gill-rakers, the typical species of *Belone* differs from all our *Tylosuri* in the form of the body, in the development in most individuals of vomerine teeth, in the posterior position of the ventrals, and in the comparatively smooth upper surface of the head. For purposes of comparison we give here a description and an outline of the synonymy of *Belone belone*. The specimens examined by us are all from Venice.

1. *Belone belone*.* Gar-fish or Needle-fish of Europe.

Esox belone Linnaeus, *Systema Naturæ*, x, 1758, 314 (and of early authors).

Belone acus Risso, *Europe Méridionale*, iii, 443, 1826, and of Cuv. & Val., Günther, etc.

Belone vulgaris Fleming, *British Animals*, 184, 1828; Cuv. & Val., xviii, 399, 1846; Günther, vi, 254; Steindachner, *Sitzb. Akad. d. Wiss., Wien*, 1868, lvii, 732; Day, *Fish. Gt. Britain and Ireland*, 147, and of most recent writers.

Ramphistoma vulgaris Swainson, *Fishes*, etc., ii, 297, 1830.

Belone rostrata Faber, *Fische Islands*, 152, 1829.

Hemirhamphus europæus Yarrell, "Mag. Nat. Hist.", 1837, 505" (Young).

Macrognathus scolopax Gronow, *Systema*, ed. Gray, 1854, 147.

Hemirhamphus obtusus Couch, "Zoology, 1978," about 1860 (Young).

Belone linnei Malm., "Bohusläns Fauna," 553, 1866.

? *Belone gracilis* Günther, vi, 252, 1846 (not of Lowe?).

? *Belone euzini* Günther, vi, 252, 1846.

? *Belone cornidii* Günther, vi, 255, 1846.

Habitat.—Mediterranean Sea and northward along the coasts of Europe to Norway and the Baltic Sea.

* If the above synonymy be correct, all the European species of *Belone* belong to a single species, *Belone belone*. The character of the absence of vomerine teeth, assumed to distinguish *Belone acus*, *euzini*, and *gracilis* from *B. vulgaris* and *B. cornidii*, has been shown to be valueless, and the differences in the size of the scales and the size of the teeth, assumed to distinguish these from each other, still lack precision of definition.

Head $3\frac{1}{4}$ in length; depth 5 in head; breadth at pectorals $9\frac{1}{2}$ in head. D. I., 16; A. 1, 19. Scales about 225; 150 series before dorsal. Length of specimen measured (from Venice) 17 inches.

Body rather slender, distinctly compressed, more so than in any of the species of *Tylosurus* proper, but much less so than in *Tylosurus hians*; caudal peduncle rather slender and long, compressed, everywhere deeper than broad, and without trace of keel of any sort.

Jaws slender and long, the upper jaw from eye contained 5 times in length of body, and 2 times length of rest of head. Mouth not capable of being completely closed, there being a slight arch at base of upper jaw. Eye rather small, $1\frac{1}{10}$ in interorbital width, $2\frac{1}{5}$ in post orbital part of head, and $6\frac{3}{4}$ in snout.

Upper jaw shorter and somewhat slenderer than lower, the jaws more unequal than in *Tylosurus*.

Teeth rather small, slender and close-set, those in upper jaw considerably larger than those in the lower, the latter most numerous; the small teeth outside of these little conspicuous. Vomer with a small patch of villiform teeth in most specimens, this occasionally little developed or obsolete (*acus* Risso). Bones and scales somewhat green.

Maxillary chiefly concealed by the preorbital.

Head strongly compressed, broader above than below.

Top of head less uneven than in the species of *Tylosurus*, rather narrow, and transversely convex, with a rather broad and very shallow median depression, which is scaly for its entire length. Superciliary and temporal ridges little prominent, scarcely striate. Two slight folds across edge of preopercle.

Cheeks with rather large deciduous scales, arranged in about 7 rows; opercle with similar scales. Scales on body rather large, but very thin and deciduous.

Gill-rakers slender and rather numerous; about 18 developed, the longest not quite as long as pupil.

Dorsal fin of moderate length and height, the posterior rays low, the anterior lobe $1\frac{2}{3}$ in postorbital part of head.

Anal higher than dorsal and inserted considerably farther forward. Caudal fin moderately forked, the lower lobe little longer than the upper, one-fourth longer than postorbital part of head.

Pectorals short and broad, $1\frac{1}{5}$ in postorbital part of head. Ventrals small, $1\frac{1}{2}$ in postorbital part of head, their insertion unusually far back, midway between axil of pectoral and base of caudal.

Color greenish above, sides and lower parts silvery; a very obscure silvery lateral streak; a dark streak along middle of back, a dusky spot on supercilium; no black bar on opercle. Fins mostly pale.

Genus II. TYLOSURUS.

TYLOSURUS Cocco, "Lettere in Giornale Sci. Sicilia, xvii," 13, 1829 (*cantraini*=*imperialis*=*acus*?).

TYLOSURUS Jordan & Gilbert, Synopsis Fish. N. A., 1833, 372.

ATHLENNES, subgenus nova (*hians*).

The name *Tylosurus* (more correctly written *Tylurus*) was framed by Cocco, for those species of this group which have a keel or callus on the side of the caudal peduncle. This character has no generic importance, but as the type of *Tylosurus* is also destitute of gill-rakers, the name must be retained by the group thus distinguished.

Tylosurus imperialis (= *cantraini*) is a rare species which we have never seen. We are indebted to our friend Dr. Vinciguerra, of Genoa, for our information in regard to it.

The American species of *Tylosurus* are numerous, for the most part well defined and easily recognizable, though very ill-described by the earlier authors. Most of them seem to have a wide geographical range.

ANALYSIS OF AMERICAN SPECIES OF TYLOSURUS.*

- a. Body not compressed, its greatest breadth more than two-thirds its greatest depth. (*Tylosurus*.)
- b. Mouth capable of being nearly or quite closed, the upper jaw not conspicuously arched at base.
- c. Caudal peduncle compressed, deeper than broad, without trace of keel along the lateral line; dorsal and anal fins short, each of 13 to 16 rays, the posterior rays not elevated; anal longer than dorsal and inserted farther forward; jaws slender, about twice as long as rest of head; no fold of skin across preopercle; caudal subtruncate, the lower lobe somewhat produced sides with a bluish-silvery band; species of small size, with the scales and bones not green.
- d. Scales comparatively large, about 85 before the dorsal fin, and about 7 or 8 rows on the cheeks; body robust, the depth about 5 in head; maxillary entirely concealed by the preorbital; ventral fins very short, not half length of postorbital part of head, their insertion nearer base of caudal than gill-opening; coloration pale, the dorsal and caudal brick-red in life; lateral stripe narrow for its entire length; no scapular blotch. D. 1, 13; A. 1, 13. Lat. 1. 150.

NOTATUS, 2.

- dd. Scales small, 140 to 150 before dorsal fin, about 12 rows on the cheeks; body slender; ventrals inserted at a point nearer cheeks than base of caudal; fins without red; lateral stripe broadened below the dorsal fin.

- e. Region above base of pectorals with a conspicuous round blackish blotch; maxillary not entirely concealed by preorbital; eye $2\frac{1}{2}$ in postorbital part of head; head $2\frac{2}{3}$ in length; depth $6\frac{2}{3}$ in head. D. 1, 14; A. 1, 15. Lat. 1. 215 SCAPULARIS, 3.

* *Tylosurus galeatus*, an ally of *T. raphidoma*, is here omitted, as being insufficiently described.

ee. Region above base of pectorals without black spot.

f. Body very slender, the depth 7 in head, which is $2\frac{5}{6}$ in body; eye moderate, $2\frac{1}{3}$ to $2\frac{3}{4}$ in postorbital part of head; no distinct notch in the temporal ridge, maxillary not entirely concealed by preorbital. D. 1, 15; A. 1, 17. Lat. 1. 225 SUBTRUNCATUS, 4.

ff. Body less slender, the depth 6 in head, which is $2\frac{9}{10}$ in body; eye large, $2\frac{1}{2}$ in postorbital part of head; a distinct notch on temporal ridge close behind eye; maxillary almost entirely concealed by the preorbital. D. 1, 15; A. 1, 17. Lat. 1. 200 EURYOPS, 5.

oo. "Caudal peduncle very much depressed, wider than deep, but without any keel or trace of one. Head $2\frac{3}{8}$ in length; eye $2\frac{1}{2}$ in postorbital part of head; top of head nearly smooth; maxillary nearly concealed by preorbital; body subterete; caudal moderately emarginate; snout very nearly twice length of rest of head; brownish above, silvery below, a bluish lateral stripe edged below with black and yellowish; scales not very small (23 rows between dorsal and anal fins). D. 16; A. 17." (Cope.)... DIPLOTÆNIA, 6.

ooo. Caudal peduncle more or less depressed, or at least, with a more or less developed dermal keel along the lateral line; scales and bones more or less green.

g. Dorsal and anal fins short, each of 14 to 19 rays, the anal larger than the dorsal and beginning farther forward; last rays of dorsal and anal low; jaws slender, about twice as long as rest of head; no folds of skin across preopercle.

h. Eye very small, 4 to 5 times in postorbital part of head; caudal keel sharp, black in color; body and tail much depressed; maxillary not entirely hidden by preorbital; caudal lunate, the lobes subequal; scales minute.

i. "Postorbital part of head rather more than half length of snout, its length 5 times diameter of eye; ventrals a little nearer head than base of caudal; head 3 in length, D. 1, 14; A. 1, 15." (Günther). MICROPS, 7.

ii. "Postorbital part of head $2\frac{3}{4}$ in length of snout; its length 4 times that of eye; ventrals midway between head and base of caudal; head about $2\frac{3}{4}$ in length." (Steindachner)..... AMAZONICUS, 8.

hh. Eye moderate, 2 to $3\frac{1}{4}$ times in postorbital part of head.

j. "Caudal fin forked; caudal keel sharp, broad and conspicuous; top of head flat, striated, without median groove; base of upper jaw much depressed; maxillary entirely hidden by preorbital; teeth very small; ventral fin midway between eye and caudal; scales not very small. D. 1, 13; A. 1, 13." (Günther.)

ARDEOLUS, 9.

jj. Caudal fin unequally lunate, the emargination not deep, the lower rays moderately produced; scales very small; sides with a silvery lateral stripe; caudal keel not very conspicuous, not black; top of head with median groove; maxillary not entirely concealed by preorbital; ventral inserted midway

- between preopercle and base of caudal. Species of moderate size, with the scales and bones more or less green.
- k.* Body very slender, the depth $6\frac{1}{2}$ to 7 in length of head; caudal keel not very small.
- l.* Posterior half of pectorals abruptly black; eye large, $2\frac{1}{2}$ in postorbital part of head. D. 1, 16; A. 1, 17. Lat. l. 250 STOLZMANNI, 10.
- ll.* Posterior half of pectorals pale, like the base of the fin; eye rather small, $2\frac{3}{4}$ in postorbital part of head. D. 1, 15; A. 1, 17. Lat. l. 370 EXILIS, 11.
- kk.* Body moderately slender, the depth $5\frac{1}{2}$ in length of head; caudal keel little developed.
- x.* Eye moderate, $2\frac{1}{2}$ in postorbital part of head; pectorals not black posteriorly. D. 1, 15; A. 1, 17. Lat. l. 300; a dark bar on opercle. MARINUS, 12.
- xx.* Eye small, $3\frac{1}{4}$ in postorbital part of head. D. 13 or 14; A. 15 or 16; pectoral pale ALMEIDA, 13.
- gg.* Dorsal and anal fins long, each of 17 to 25 rays, the last rays of the dorsal fin more or less elevated in the young, becoming lower in the adult; caudal keel rather strong, black; one or more folds of skin across the edge of the preopercle; caudal fin deeply emarginate or unequally forked. Ventrals inserted midway between base of caudal and middle of eye. Species of large size, with the scales and bones green; no distinct lateral stripe.
- m.* Beak short and very strong, its length $1\frac{1}{2}$ to $1\frac{3}{5}$ times length of rest of head; body comparatively robust, the depth more than one-fifth length of head.
- n.* Dorsal fin of moderate length, its rays 1, 16; anal rays 1, 17; insertion of dorsal notably behind that of anal; snout very short, $1\frac{1}{2}$ times length of rest of head. Lat. l. 440 FODIATOR, 14.
- nn.* Dorsal fin long, its rays 1, 21 to 1, 24; anal rays 1, 22 to 1, 24; insertion of dorsal almost opposite that of anal; snout longer, $1\frac{3}{5}$ to $1\frac{1}{5}$ length of rest of head. Lat. l. about 350 RAPIDOMA, 15.
- mm.* Beak strong, but more elongate, its length about twice length of rest of head; dorsal beginning behind front of anal.
- o.* "Greatest depth of body equal to length of pectoral; teeth shorter and weaker than in *T. acus*. D. 21 to 22; A. 19 or 20; a grayish lateral streak" (*Steindachner*) PACIFICUS, 17.
- oo.* Greatest depth of body about two-thirds length of pectoral. D. 1, 23; A. 1, 21. Lat. l. 380; no lateral stripe ACUS, 18.
- bb.* Mouth not closing completely, the upper jaw arched at base, somewhat as in *T. hians*; lobes of dorsal and anal low, the last rays elevated; depth 20 in total length with caudal; head $3\frac{2}{5}$; body broad, compressed; breadth of body $\frac{2}{3}$ its depth, which is about equal to postorbital part of head; preopercle with folds of skin; eye $10\frac{1}{4}$ in head, $2\frac{1}{10}$ in postorbital part; beak

slender, more than twice as long as rest of head; teeth rather weak; preopercle with two cross-folds of skin; caudal peduncle with a strong, black keel; caudal fin moderately forked, the lower lobe much the longer; dorsal inserted a little behind anal; ventrals midway between base of caudal and middle of eye; skull narrow. D. 1, 24; A. 1, 22. Scales small, green, about 210 before dorsal. Bluish white below, a faint bluish band along sides; fins bluish CARIBBEUS, 19.

aa. Body very strongly compressed, its greatest breadth not half its greatest depth (*Athlennes*); caudal peduncle not compressed, without keel; jaws long and very slender, the upper strongly arched upward at base, so that the mouth cannot be closed: snout twice length of rest of head; eye large. $2\frac{1}{2}$ in postorbital part of head; maxillary entirely concealed by preorbital; a fold of skin across preopercle; opercle smooth; insertion of ventrals well forward, midway between front of arch of upper jaw and base of caudal; caudal deeply forked: dorsal and anal falcate, the latter beginning farther forward; pectorals long, falcate: scales minute: species of large size with scales (and bones) green: no lateral band: sides silvery, with round, dark blotches in youth; fins with black tips. D. 1, 25; A. 1, 26. Lat. l. about 520 HIANS, 20.

2. *Tylosurus notatus*.

Belone notata Poey, *Memorias*, ii, 293, 1860 (Havana); Günther, vi, 1866, 248 (Jamaica); Poey, *Synopsis Pisc. Cubens.*, 1868, 382; Poey, *Enumeratio Pisc. Cubens.*, 1875, 120; Goode, *Proc. U. S. Nat. Mus.*, 1879, 151 (Pensacola).

Tylosurus notatus Jordan & Gilbert, *Syn. Fish. N. A.*, 1883, 373 (copied); Jordan, *Proc. U. S. Nat. Mus.*, 1884, 111 (Key West); Bean & Dresel, *Proc. U. S. Nat. Mus.*, 1884, 168 (Jamaica); Jordan, *Cat. Fish. N. A.*, 59; Jordan, *Proc. U. S. Nat. Mus.*, 1886, 33 (Havana).

Habitat.—West Indian fauna, north to Pensacola.

Head, $2\frac{1}{2}$; depth, 5 in head. D. 1, 13. A. 1, 13. Length (418, Key West), 16 inches.

Body robust, not at all compressed, scarcely deeper than broad, except at base of caudal; the breadth of body between pectorals 6 in head; no keel on caudal peduncle, the lateral line not black and not more conspicuous on the tail than elsewhere.

Jaws slender, rather long, the upper jaw from eye contained 4 times in length, and $1\frac{2}{3}$ times length of rest of head. Mouth capable of being completely closed. Eye large, its diameter equal to interorbital width, $2\frac{1}{4}$ in postorbital part of head and 6 in snout.

Teeth slender and pointed, those of the inner row on each side, in each jaw, enlarged, about 25 of them being canine-like. Teeth and bones of head not green. Maxillary entirely concealed by the preorbital. Interorbital space, with a rather broad and deep median groove, which is widened and scaly anteriorly, with an inconspicuous median

ridge. Temporal and superciliary angles sharply defined, the bones above with radiating striæ. A very slight notch on temporal ridge, behind eye. Vertex with a blunt median ridge, on each side of which is a depression. Two parallel ridges on each side of occiput. No fold of skin across lower posterior edge of preopercle. Cheeks with rather large scales in 7 or 8 series; opercles with smaller scales.

Scales comparatively large, loose, not green, 85 before the dorsal fin, about 150 in the lateral line.

No gill rakers.

Dorsal fin short and rather high, the last rays short, the anterior lobe $1\frac{1}{2}$ in postorbital part of head. Base of fin a little longer than postorbital part of head. Anal longer and higher than dorsal, beginning in front of the latter. Caudal subequally lunate, little notched, the lower lobe short, about equal to postorbital part of head. Pectorals $1\frac{1}{8}$ in postorbital part of head. Ventrals very short, $2\frac{1}{3}$ in postorbital part of head, placed unusually far back, their insertion midway between base of median caudal rays and axil of pectoral.

Color, in life, very pale greenish, the lateral stripe well defined, silvery bluish, about one-third pupil, and not widened below dorsal. Edges of scales above with many dark points. A narrow blue-black line along edge of each jaw. Tips of all the vertical fins of a conspicuous pale brick-red. Other fins pale olivaceous. A blue-black vertical blotch on front of opercle above. No axillary or scapular blotch. Lining of opercles dark.

Color in spirits very pale, with a narrow greenish lateral band and black opercular blotch. This species is very common in the West Indies, as also about the Florida Keys. It is one of the most strongly marked of the group, and since its discovery has been confounded with no other.

3. *Tylosurus subtruncatus*.

Tylosurus scapularis Jordan & Gilbert, Bull. U. S. Fish Comm., 1881, 307; 1882, 109 (Panama); Jordan, Proc. U. S. Nat. Mus., 1885, 370 (Panama).

Habitat.—Pacific coast of tropical America; Panama.

Only the original types of this species are known. It is very close to *T. subtruncatus*, but, by its coloration at least, it may be easily distinguished.

4. *Tylosurus subtruncatus*.

Belone subtruncata Poey, Memorias Cuba, ii, 1861, 295 (Havana); Poey, Synopsis, 1863, 332; Poey, Enumeratio, 1875, 120.

Belone depressa Poey, Memorias Cuba, ii, 296, 1861 (Havana); Poey, Synopsis, 1863, 332; Poey, Enumeratio, 1875, 120 (not of Günther).

Tylosurus sagitta Jordan & Gilbert, Proc. U. S. Nat. Mus., 1884, 25 (Key West); Jordan, l. c. 1884, 112 (Key West); Jordan, Cat. Fish. N. A., 59, 1885.

Habitat.—West Indian fauna; Key West and southward to Cuba.

Head, $2\frac{3}{8}$ in length; depth, 7 in head; breadth, at pectoral, 8 in head. D. 1, 15; A. 1, 17. Lat. l. 225. Scales before dorsal, about 150. Length of specimen, 13 inches.

This species has been well described in the Proc. U. S. Nat. Mus. under the name of *Tylosurus sagitta*. Examination of five specimens from Key West shows some variation in the size of the eye, as follows:

Eye in interorbital width.	In postorbital.	In head.
$\frac{9}{10}$	$2\frac{1}{2}$	$10\frac{1}{2}$
1	$2\frac{1}{2}$	$10\frac{1}{2}$
1	$2\frac{1}{2}$	$10\frac{1}{2}$
1	$2\frac{1}{2}$	10
$1\frac{1}{8}$	$2\frac{1}{2}$	$11\frac{1}{2}$

Contrary to the usual rule, the eye seems to be proportionately smaller in the younger specimens.

Depth of body at pectoral, $1\frac{5}{6}$ in postorbital part of head; breadth at pectoral, 2; caudal subtruncate, the lower lobe produced, longer than postorbital part of head.

This small species is rather scarce in the waters about Key West. We have seen no specimens from any other locality, but there seems to be good reason for believing that its range extends throughout the West Indies.

Belone subtruncata of Poey agrees well with our specimens. The eye ($2\frac{1}{2}$ in postorbital part of head) is too small for *T. euryops*.

The type of *Belone depressa* Poey is in the National Museum. This has been compared with the types of *T. sagitta*, by Dr. Bean, who informs me that they are identical.

It is possible that Maregrave's figure of the Timucu, or *Esox brasiliensis** L., belongs to this species, but of this there can be no certainty.

5. *Tylosurus euryops*.

Tylosurus euryops Bean & Dresel, Proc. U. S. Nat. Mus. 1884, 168 (Jamaica); Jordan, Proc. U. S. Nat. Mus. 1886, 35 (Havana).

Habitat.—West Indian Fauna; Cuba, Jamaica.

Head, $2\frac{3}{10}$; depth, 6 in head; breadth, 7. D. 1, 15; A. 1, 17. Lat. l. about 200. Scales before dorsal 140. Length (958, Havana), $12\frac{1}{2}$ inches.

Body slender, more robust than in *T. subtruncatus*, not at all compressed, scarcely deeper than broad, except at base of caudal; no keel on caudal peduncle, the lateral line not black, and not more conspicuous there than elsewhere.

Jaws slender, long, the upper jaw from eye contained $4\frac{1}{2}$ times in length, and $1\frac{7}{8}$ times the length of the rest of the head. Mouth capable

* The following is the Linnæan description: "Brasiliensis, 8. E. maxilla inferiore longissima, corpore serpentino. D. 12, P. 10, V. 6. A. 17, C. 16."

"Maregr. bras., 168, Timucu, Brown, jam. 443, T. 45, f. 2. Esox maxilla inferiore producta.

"Habitat in America australi."

of being completely closed. Eye large, distinctly larger than in *T. subtruncatus*, its diameter a little less than interorbital width, $2\frac{1}{5}$ in post-orbital part of head, and 6 in the snout.

Teeth small and slender, those of the inner row on each side in each jaw fewer and smaller than in *T. notatus*. Teeth, bones, and scales not green.

Maxillary almost entirely covered by the preorbital.

Interorbital space with a rather broad and deep median groove, which is widened and scaly anteriorly, with a slight median ridge. Superciliary ridge rather sharp, temporal ridge less acute, all the bones of upper part of head with rather sharply defined ramose radiating striæ. A sharp notch in the temporal ridge, close behind eye. Vertex nearly flat, with a blunt ridge on either side. No distinct fold of skin on lower posterior edge of opercle.

Cheeks with moderate scales, in about 12 series. Opercles with very small scales.

Scales small, not green.

No gill-rakers.

Dorsal fin rather short and low, the last rays short, the anterior lobe $1\frac{1}{2}$ in postorbital part of head. Base of fin half more than postorbital part of head. Anal longer and higher than dorsal and beginning a little before it. Caudal subtruncate, with the lower lobe produced, the lower lobe about equal to postorbital part of head. Pectorals $1\frac{1}{4}$ in postorbital part of head. Ventrals $1\frac{3}{4}$; their insertion midway between base of middle caudal rays and posterior margin of pupil.

Color dusky greenish above, the dark color produced by dark punctulations. Sides and belly pale. A well-defined dark-bluish lateral stripe which is narrow and sharply defined toward the head, becoming broader behind the middle of the body. An obscure dusky streak along middle of back. A faint dusky bar on front of opercle. Axil dusky. Fins all dusky olivaceous, the tips darker, except in the pectoral, which is rather pale. Lining of opercles dark.

A single specimen obtained by Dr. Jordan in the market at Havana furnishes our knowledge of this species. It is very close to *T. subtruncatus*, but it is more robust, with larger eye and somewhat different sculpture of the bones of the head.

Dr. Bean has compared the type of *T. euryops* with the types of *B. depressa* and *T. sagitta*, and notes the same differences.

Poey seems not to have distinguished this fish from his *subtruncata* and *depressa*.

6. *Tylosurus diplotænia*.

Belone diplotænia Cope, Trans. Am. Philos. Soc., 1871, 481 (St. Martin's).

Habitat.—West Indian Fauna.

This species is known to us only from the description of Professor Cope.

7. *Tylosurus microps*.

Belone microps Günther, Cat. Fish. Brit. Mus., vi, 237, 1886 (Surinam).

Habitat.—Brazilian Fauna; Surinam.

This species is known to us only from Dr. Günther's description.

8. *Tylosurus amazonicus*.

Belone amazonica Steindachner, Ichth. Beitr., iii, 66, 1875 (Amazon River, at Pará, Manacapuru, and Tajapuru).

Habitat.—Brazil; mouth of the Amazon.

This species is known to us only from the account given by Dr. Steindachner. It seems to be very close to *T. microps*, and as Steindachner has suggested, it may prove identical with the latter.

9. *Tylosurus ardeolus*.

?*Belone ardeola* Cuv. & Val., xvii, 1846, 425 (Martinique).

?*Belone cigonella* Cuv. & Val., xviii, 1846, 436 (Porto Rico).

?*Belone argalus* Le Sueur MSS., Cuv. & Val., xviii, 1846, 439 (Guadeloupe).

Belone depressa Günther, vi, 1866, 235. (Dominica; Jamaica) (not of Poey).

Habitat.—West Indian Fauna.

Dr. Günther has described, under the name of *Belone depressa*, a species apparently valid, but having little in common with the *Belone depressa* of Poey, which is our *Tylosurus subtruncatus*. Species more or less similar to this of Günther have been very briefly and insufficiently described by Valenciennes under the names of *ardeola*, *cigonella*, and *argalus*. We refer all these names provisionally to one species, *ardeolus*, which is unknown to us. The types of none of these species are now to be found in the museum at Paris.

10. *Tylosurus stolzmanni*. "Sierrita."

Belone stolzmanni Steindachner, Ichth. Beitr., vii, 21, 1878 (Tumbez, Peru).

Tylosurus stolzmanni Jordan, Proc. U. S. Nat. Mus., 1885, 370 (Mazatlan); Jordan, Cat. Fish. N. A., 59.

Tylosurus sierrita Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 458 (Mazatlan); Jordan & Gilbert, Bull. U. S. Fish Comm., 1882, 106 (Mazatlan).

Habitat.—Pacific Coast of tropical America; Mazatlan; Peru.

This species is the southern representative of *T. exilis*, from which it differs in little except the marked coloration of the pectorals. The description of *Belone stolzmanni* from Peru agrees too closely with that of *T. sierrita* from Mazatlan for us to regard the two as distinct. It has been well described in these proceedings under the name of *T. sierrita*.

11. *Tylosurus exilis*. California Needle-fish.

Belone exilis Girard, Proc. Ac. Nat. Sci. Phila., 1854, 189 (San Diego, Cal.); Girard, U. S. Pac. R. R. Surv. 1859, 158 (San Diego); Günther, vi, 1866, 233 (copied); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 30 (San Diego).

Tylosurus exilis Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 457 (Santa Barbara; San Pedro; San Diego); Jordan & Jony, Proc. U. S. Nat. Mus. 1881, 13 (San Diego); Jordan & Gilbert, l. c. 1881, 43 (Santa Barbara; San Diego); Jordan & Gilbert, Synopsis Fish. N. A., 1883, 374; Jordan, Cat. Fish. N. A., 1885, 59.

Habitat.—Coast of Southern California.

Head $2\frac{4}{5}$; depth 7 in head; breadth at pectorals 9. D. 1.15, A. 1.17. Scales 370; 280 before dorsal. Length (specimen from San Diego) 13 inches.

Body very slender, subterete, the depth medially little more than the breadth. Caudal peduncle very slender, depressed, broader than deep, the lateral line passing into moderately elevated keel, which is similar to that in *T. marinus*, but a little more conspicuous. Caudal keel scarcely darker in color than the surrounding region.

Jaws very long and slender, the upper jaw from eye $3\frac{1}{2}$ times in the length and 2 times length of rest of head.

Mouth closing almost completely, the base of the upper mandible scarcely arched at all. Eye small, about equal to interorbital width, $2\frac{3}{4}$ in postorbital part of head, and 8 in snout.

Teeth sharp and slender, about 25 in the enlarged outer series in each jaw, the small teeth between these numerous, but rather short.

Scales and probably bones also somewhat green, but less so than in *T. marinus*, much less so than in *T. raphidoma*.

Maxillary not nearly concealed by preorbital.

Interorbital area with a rather deep scaly median depression, which becomes much wider on the snout, its median ridge very small. Superciliary and temporal ridges little prominent, scarcely striate, the temporal ridge nearly straight, without notch behind eye, but with a distinct lateral process about as long as pupil above preopercle. Vertex not depressed. No fold of skin across preopercle.

Cheeks and opercles covered with very small scales, the cheek scales in about 27 rows. No gill rakers.

Dorsal fin rather low, the posterior rays low; the anterior lobe $1\frac{1}{2}$ in postorbital part of head; base of the fin equal to eye and postorbital part of head.

Anal higher than dorsal, and beginning considerably farther forward.

Caudal fin formed as in *T. marinus*, the lower lobe one-fifth longer than postorbital part of head. Posterior margin of the fin slightly lunate.

Pectorals $1\frac{1}{8}$ in postorbital part of head. Ventrals $1\frac{3}{4}$, their insertion midway between base of middle caudal rays and edge of preopercle.

Color light green, silvery below. A distinct bluish-silvery lateral band which becomes broader under the dorsal fin. Opercular bar very faint or obsolete. Fins all pale, the caudal and dorsal with some dark points, becoming a little dusky.

This species is common on the coast of Southern California, where it represents the *marinus* of the Atlantic Coast. In all respects of size and habits the two are remarkably similar, and the Pacific species is scarcely distinguishable except by the greater slenderness of the body.

12. *Tylosurus marinus*. Common Gar-fish, Bill-fish, or Needle-fish.

Bill-fish, Schöpfung, Schrift. Gesellsch. Naturf. Freunde, viii, 177, 1788 (Long Island).

Esox belone var. *marinus* Bloch & Schneider, Systema Ichthyol., 1801, 391 (description erroneous; after Schöpfung).

Tylosurus marinus Jordan & Gilbert, Syn. Fish. N. A., 1883, 901; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 387 (Charleston); Bean, Proc. U. S. Nat. Mus., 1883, 366 (Havre de Grace); Jordan & Swain, Proc. U. S. Nat. Mus., 1884, 231 (Cedar Key, Fla.); Jordan, Cat. Fish. N. A., 1885, 59; Jordan, Proc. U. S. Nat. Mus., 1885 (Beaufort).

Esox longirostris Mitchill, Am. Monthly Mag., ii, 1818, 322 (Hudson R.).

Belone longirostris Gill, Cat. Fish. East Coast N. A., 1861, 38; Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 368 (Neuse R., N. C.); Jordan & Gilbert, l. c., 1878, 383 (Beaufort, N. C.); Bean, Proc. U. S. Nat. Mus., 1879, 31 (Kiel Bay); Goode, l. c., 1879, 116 (St. John's River, Florida); Bean, Proc. U. S. Nat. Mus., 1879, 150 (Pensacola); Bean, l. c., 1880, 103 (Noank, Conn.; Wood's Holl. Mass.).

Tylosurus longirostris Jordan & Gilbert, Syn. Fish. N. A., 1883, 374.

Belone truncata Le Sueur, Journ. Ac. Nat. Sci. Phila., i, 126, 1821 (New York Market; Philadelphia Market; Newport Market); Storer, Rept. Fish. Mass., 1839, 98 (Holmes' Hole, Martha's Vineyard); De Kay, New York Fauna, Fishes, 1842, 227, pl. 35, f. 112; Storer, Synopsis, 1846, 186; Cuvier & Valenciennes, Hist. Nat. Poiss., xviii, 422 (New York; Philadelphia; Newport; New Orleans).

Belone truncata Günther, vi, 1866, 244 (New Orleans; in part; other localities mentioned, "Jamaica," "Bahia," "Demerara," probably belong to *T. almeida*).

Belone scrutator, Girard, U. S. Mex. Bound. Surv., Ichth., 30, pl. 13, f. 1, 1859 (Brazos Santiago; Saint Joseph's Island, Texas).

Habitat.—Atlantic Coast of the United States, from Cape Cod to Northern Florida and Texas, ascending all the rivers.

Head, $2\frac{4}{5}$; depth, $5\frac{1}{2}$ (in head); breadth at pectorals, $7\frac{1}{4}$ in head. D. 1. 15, A. 1. 17. Scales, 300; 240 series before dorsal. Length (3646; Beaufort, N. C.), 22 inches.

Body rather slender, not at all compressed; almost as broad as deep medially; caudal peduncle depressed, broader than deep, the lateral line passing into a slight elevated ridge or keel, which is not black.

Jaws slender, long; the upper jaw, from eye, contained $4\frac{1}{2}$ times in length, and 2 times length of rest of head. Mouth not capable of being completely closed, there being a very slight arch of base of upper mandible. Eye moderate, proportionately larger in adult specimens, about $1\frac{1}{6}$ in interorbital width, $2\frac{1}{4}$ to $2\frac{1}{2}$ in postorbital part of head and 7 in snout.

Teeth rather large; about 30 of the large teeth in the outer row on each side of each jaw, the small teeth between and outside of these unusually large and conspicuous.

Bones and scales more or less green.

Maxillary not nearly concealed by the preorbital.

Interorbital area with a broad, shallow scaly depression, which has a rather broad median ridge. Superciliary and temporal ridges mod-

erately prominent, coarsely striate. Vertex flattish, not depressed. Temporal ridge without distinct notch behind eye. Two parallel ridges on each side of occiput. No fold of skin across preopercle on lower posterior margin.

Cheeks covered with small scales in about 16 rows; opercle covered with similar scales which are scarcely smaller.

No gill-rakers.

Dorsal fin of moderate length and height, the posterior rays low, even in young specimens, the anterior lobe $1\frac{1}{2}$ in postorbital part of head; base of the fin equal to eye and postorbital part of head.

Anal a little higher than dorsal, and beginning a little farther forward.

Caudal slightly lunate, the middle rays a little shorter than upper; the lower a little produced, a little longer than postorbital part of head.

Pectorals equal to postorbital part of head. Ventrals $1\frac{1}{2}$ in postorbital part of head, their insertion midway between origin of middle caudal rays and edge of preopercle.

Color, clear greenish above, sides and below silvery; a narrow, bluish silvery lateral streak, less distinct than in *T. subtruncatus* and *T. notatus*, becoming wider and usually fainter under the dorsal. This stripe is usually plainer in young examples. A conspicuous dark bar on front of opercle. A dark median stripe on back. Fins dusky olivaceous, with no distinct black markings. Axil dusky.

The synonymy of this species offers little room for doubt. The description given by Bloch & Schneider amounts to nothing, but such as it is, it is drawn from Schöpfung, and no doubt seems to exist as to what Schöpfung had in mind.

The synonymy, as well as the description given by Dr. Günther, indicates the confusion of this species with others, especially with *T. almeida*. No other author seems to have recorded *T. marinus* from the West Indies, and we question its occurrence there. It is not found at Key West or Havana.

13. *Tylosurus almeida*.

? *Timucu* Maregrave, Pisc. Brasil., 1648, 168 (Brazil).

? *Esox brasiliensis* Linnaeus, Systema Naturæ, ed. x, 1748, 314 (in part based on *Timucu* of Maregrave, and on a description of a *Hemirhamphus* from Jamaica by Brown, the name *brasiliensis* evidently taken from Maregrave; the description chiefly from Brown; not of Bloch, who uses the name for a *Hemirhamphus*).

Belone almeida Quoy & Gaimard, Voyage de l'Uranie, Zool., 226, 1824 (fide Cuv. & Val.).

Belone timucu Cuvier & Valenciennes, xviii, 1846, 426 (Rio Janeiro); Guichenot "Ramon de la Sagra, Poiss., pl. 4, f. 1, abt. 1860" (Cuba).

Belone truncata var. *guianensis* Günther, vi, 245, 1866 (Surinam); (not of Müller & Troschel).

Habitat.—West Indian Fauna; Cuba to Brazil.

Typical examples of *Belone timucu* in the museum at Paris belong to

a species very close to *T. marinus*, differing chiefly in the smaller eye (3 to $3\frac{1}{4}$ in postorbital part of head) and in the fewer fin-rays (D. 13 or 14; A. 15 or 16). The type of *Belone almeida* Q. & G. is regarded by Valenciennes as identical with his *B. timucu*, but the scanty description of Quoy and Gaimard is of little value for purposes of identification. The species was named for Don Fr. Almeida, a young secretary of the Portuguese legation at Paris.

This species may be the *Timucu* of Maregrave, and therefore the original *Esox brasiliensis* of Linnæus, but the figure of Maregrave looks even more like the *T. subtruncatus* than like *T. almeida*.

Doubtless further material will show *T. almeida* to be the southern representative or subspecies of *T. marinus*, as supposed by Dr. Günther, and the two may be wholly inseparable.

14. *Tylosurus fodiator*.

Tylosurus fodiator Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 859 (Mazatlan); Jordan & Gilbert, Bull. U. S. Fish Com., 1882, 106 (Mazatlan); Jordan, Proc. U. S. Nat. Mus., 1885, 370; Jordan, Cat. Fish. N. A., 1885, 59.

Habitat.—Pacific Coast of Mexico; Mazatlan.

This very large and robust species has been thus far found only about Mazatlan. It represents on the Pacific coast the *raphidoma* of the Atlantic.

15. *Tylosurus raphidoma*. Hound-fish; Aguja de Casta.

Belone raphidoma Ranzani, Nov. Comm. Acad. Sci. Inst. Bonon, v, 1842, 359, pl. 37, f. 1 (Brazil); Günther, vi, 249, 1846 (copied).

Tylosurus raphidoma Jordan, Proc. U. S. Nat. Mus., 1886, 35 (Havana).

Belone gerania Cuv. & Val., xviii, 437 (Martinique); Günther, vi, 241, 1846 (copied).

Belone crassa Poey, Memorias, ii, 291, 1861 (Cuba); Poey, Synopsis, 1868, 382; Poey, Repert., ii, 1869, 165; Enumeratio, 1875, 120.

Tylosurus crassus Jordan, Proc. U. S. Nat. Mus., 1884, 112 (Key West); Jordan, Cat. Fish. N. A., 1885, 59.

Belone melanochira Poey, Memorias, ii, 294, 1861 (Havana); Günther, vi, 249, 1866 (copied); Poey, Synopsis, 1868, 382; Poey, Enumeratio, 1875, 120.

Tylosurus gladius Bean, Proc. U. S. Nat. Mus., 1882, 430 (Pensacola); Jordan & Gilbert, Synopsis Fish. N. A., 1883, 901; Bean & Dresel, Proc. U. S. Nat. Mus., 1884, 168 (Jamaica).

Adult ($26\frac{1}{2}$ inches in length), from Key West. Head, $3\frac{1}{3}$ in length; depth at pectoral, $4\frac{3}{4}$ in head; breadth at pectoral, $5\frac{1}{5}$ in head; depth in postorbital part of head, $1\frac{1}{4}$; breadth in same, $1\frac{1}{2}$. Eye in head, 9; in postorbital part, $2\frac{1}{5}$; D. I, 21 to I, 24; A. I, 21 to I. 23; lat. l. more than 300; 225 scales before dorsal.

Young ($19\frac{1}{2}$ inches), from Key West. Head, $3\frac{1}{6}$; depth at pectoral, $5\frac{1}{4}$ in head; breadth at pectoral, $5\frac{5}{6}$ in head; depth in postorbital part, $1\frac{1}{4}$; breadth, $1\frac{1}{2}$. Eye in head, $8\frac{1}{2}$; in postorbital part, $2\frac{1}{10}$. Dorsal fin inserted almost opposite front of anal; the latter less advanced than in other species. Anal fin shorter than dorsal.

This species has been well described, both by Dr. Bean and by Dr. Jordan. It seems to be common through the West Indies, the numerous specimens before us, of all sizes, being from Key West and Havana.

This is certainly the *gladius* of Bean, and the *crassa* of Poey. A type of *Belone melanochira* of Poey is in the National Museum, and this, Dr. Bean informed us, is identical with young specimens of the present species collected by Dr. Jordan at Key West.

The *Belone gerania* of Valenciennes is scantily described, but the probabilities are that this species was intended, although some of the measurements are erroneous, or, at least, ambiguous (son bec * * * "ne dépasse la longueur de la joue que d'un cinquième"). The eye in *B. gerania* would seem to be unusually large, more than half the post-orbital part of the head. We have not seen the original account of *Belone raphidoma*. The extract given by Dr. Günther applies best to this species, with which Günther has identified it. The statement that the origin of the dorsal is opposite that of the anal especially indicates this species rather than *T. acus*, in which the anal begins farther forward. A tracing of Ranzani's figure of *B. raphidoma* has been sent to us by Mr. Garman. It agrees entirely with the present species. The type of *Belone crassa* Poey, now in the museum at Cambridge, has been compared by Mr. Garman with Ranzani's description, and no differences are apparent. There is, therefore, apparently no doubt that the name *raphidoma* should be retained for this species.

Young specimens of this species have the beak more slender and rather longer proportionally, the last rays of the dorsal more elevated, and the tips of the fins, especially the posterior half of the pectoral, more decidedly black.

16. *Tylosurus galeatus*.

Belone galeata Cuv. & Val., Hist. Nat. Poiss., xviii, 1846, 429 (Cayenne).

Habitat.—West Indian Fauna.

We know this species only from the description given by Valenciennes. If this be correct, it should be a species distinct from *T. raphidoma*, from which it seems to differ in the fin-rays (D. 15, A. 17), and in having the caudal little forked, with no keel on its peduncle; from *T. notatus* it would seem to differ in having the beak rather strong and only $1\frac{2}{3}$ times the length of the rest of the head. The scales are said to be small, and the description* of the upper part of the head suggests *T. raphidoma*. We are unable to find the type either of *B. gerania* or *B. galeata* in the museum at Paris.

* "Remarquable par l'espèce de casque osseux que dessinent sur la tête les os du crâne ; toute leur surface est lisse ; la cannelure est très large et comme évasée dans la région des os du nez ; les bords ont des échancrures qui rappellent à certains égards ceux d'un violon." (Cuv. & Val.).

17. *Tylosurus pacificus*.

Belone pacifica Steindachner, Ichth. Beitr., iii, 65, 1875 (Panama; Acapulco).
Tylosurus pacificus Jordan & Gilbert, Proc. U. S. Nat. Mus., 1882, 624 (Panama); Jordan, Proc. U. S. Nat. Mus., 1885, 370 (Panama).

Habitat.—Panama Fauna; Acapulco, Panama.

This species is the Pacific coast representative of *T. acus*, from which it is scarcely to be distinguished except by the rather stouter body, smaller teeth, and shorter vertical fins. Two or three specimens were found by Professor Gilbert in the markets of Panama.

18. *Tylosurus acus*. Hound-fish; Agujon.

Sphyræna acus Lacépède, Hist. Nat. Poiss., v, 1803, 6, pl. 1, f. 3. (Martinique; from a drawing by Plumier.)

Tylosurus acus Bean, MSS.

?*Esox imperialis* Rafinesque, Caratteri di Alcuni Nuovi Generi, 1810, 59 (Palermo).

?*Tylosurus imperialis* Doderlein, Prospetto Metodico Pesci della Sicilia, 1879, 58 (Palermo).

Belone caribbæa Günther, vi, 1866, 241 (Dominica; Jamaica; New Orleans); Cope, Trans. Am. Phil. Soc., 481, 1871 (Lesser Antilles) (not of Le Sueur).

Tylosurus caribbæus Jordan, Cat. Fish. N. A., 1885, 59; Jordan, Proc. U. S. Nat. Mus., 1886, 26 (Beaufort).

?*Tylosurus castrainii* Cocco, "Lettere in Giorn. Sci. Lett. Sic., xviii, 18, tab. 1, f. 4, 1829" (Messina); Bonaparte, Fauna Ital. Pesc.

?*Belone castrainii* Cuv. & Val., xviii, 418, 1846 (copied); Günther, vi, 242 (copied).

Belone latimana Poey, Memorias Cuba, ii, 290, 1861 (Havana); Günther, vi, 1866, 249 (copied); Goode, Proc. U. S. Nat. Mus., 1878, 6 (Buzzard's Bay, Mass.).

Belone jonesi Goode, Amer. Journ. Sci. Arts, 1877, 295 (Bermuda); Goode, Proc. U. S. Nat. Mus., 1878, 462 (Bermuda).

Belone jonesi Günther, Ann. Mag. Nat. Hist., iii, 1879, 150 (Bermuda).

Belone hians Jordan & Gilbert, Proc. U. S. Nat. Mus., 1878, 353 (Beaufort, N. C.; Young).

Habitat.—West Indian Fauna. Bermudas, straying northward to Cape Cod, and perhaps crossing the ocean to Sicily.

It is possible that more than one species is included in the above synonymy, but so far as we can decide, all these names refer to a single species, widely distributed and varying somewhat with age.

The best description of this species extant is that of Professor Goode under the name of *Belone jonesi*, and his description we may now adopt for this species as understood by us.

So far as the description goes, the *jonesi* of Günther may be either this species or *raphidoma*, but as Günther's types as well as Goode's came from Mr. J. Matthew Jones at Bermuda, we may accept, as unquestioned, Goode's statement that the two are identical. We have seen that the height of the last dorsal rays is subject to great variation in *T. raphidoma*, the young as a rule having these rays elevated, as also some old examples, while in others, these rays are short, the tips being apparently worn off. According to Dr. Bean, who has compared specimens of *T. latimanus* with the types of *T. jonesi*, no other tangible differences

exist and these may all be regarded as forming a single species. It is probable also, as Dr. Bean has already noticed, that the *Sphyræna acus*, roughly figured by Lacépède, is the same species. The long snout separates it from *raphidoma*, the small eye from *T. caribbæus*, and the long fins and other characters distinguish it from the other West Indian species. The species should then, without much doubt, be designated as *Tylosurus acus*.

The *Belone caribbæa* of Le Sueur may be the same, but in the specimens in the museum at Paris the eye is very large, larger than in *B. hians* and half the postorbital part of the head. These have a similar prolongation of the last rays of the dorsal. The upper jaw in *T. caribbæus* is arched at base, somewhat as in *T. hians*. In Günther's description of *Belone caribbæa*, the last rays of the dorsal are said to form a lobe as high as the anterior lobe, while the eye is said to be $2\frac{1}{2}$ times in the postorbital part of the head.

If Günther's *Belone caribbæa* with the elevated posterior dorsal rays be regarded as synonymous with *T. acus*, there seems to be no reason why the European *T. imperialis* (= *T. cantraini*) may not be the same species also. This species is rather rarely taken off the coasts of Sicily, according to the Italian authors. Its descriptions agree fully with those of our *acus*, excepting in the elevation of the dorsal fin, in which it agrees with Günther's account of *T. caribbæus*, and with a young example of *T. acus* taken by Dr. Jordan at Beaufort. If this identification be correct, this will be another example of fishes common to Mediterranean and West Indian waters (as *Mycteroperca scirenga*, *Sparus pagrus*, *Mullus surmuletus*, etc.).

Rafinesque's rough figure of his *Esox imperialis* shows the upper jaw very slightly arched at base. It may be that his fish is our *T. caribbæus*, if indeed that be not the same as *T. acus*. In any case, the nomenclature of neither species can be regarded as definitely settled.

We are indebted to Professor Pietro Doderlein for the following notes (here translated from the Italian) in regard to the Italian species known as *Tylosurus imperialis*:

"As to *Tylosurus imperialis*, I will say that I find the figure and description of Lacépède (*Esox belone*, 1, v, pl. 7, p. 308) corresponding closely to the species in question (with the exclusion of a great part of the synonymy). In this it is evident that Lacépède has confused several different species. I find that this species corresponds in many characters with *Belone caribbæa* Le Sueur, Günther, and the *Belone latimana* Poey, and I presume that these forms represent a single species, as you have already suggested (Syn. Fish. N. A., pp. 901, 397). As you know, certain small differences may always exist among individuals from different waters, and between adults and young. This is here the case. The number of rays in the vertical fins is variable in certain limits, the number seemingly increasing with age. The length of the snout is also variable, being a little longer in proportion in the young. But

this will not prevent us from seeing in these a single identical species, all the characters of importance being always alike.

"The museum of Palermo has of this *Tylosurus* three large prepared skins, two skeletons, and one young specimen in alcohol. For better comparison I give here the measurements of all these:

	Studied specimen, total length M. 1.22.	Studied specimen, total length M. 0.95.	Studied specimen, total length M. 0.94.	Skeleton, total length M. 0.955.	Skeleton, total length M. 0.94.	Young example in alcohol, length M. 0.408.
Length from tip of snout to front of dorsal	M. 0.90	M. 0.70	M. 0.69	M. 0.695	M. 0.685	M. 0.295
Length from tip of snout to origin of ventral . . . . .	.70	.53	.53	.54	.526	.226
Length from tip of snout to origin of pectoral . . . . .	.31	.26	.26	.264	.26	.115
Length from tip of snout to front of eye . . . . .	.20	.17	.17	.17	.17	.08
Distance from front of eye to gill opening . . . . .	.11	.08	.08	.085	.084	.034
Length of head . . . . .	.315	.253	.26	.265	.264	.116
Depth at pectoral . . . . .	.059	.059	.06			
Dorsal rays	25	24	24	25	24	23
Anal rays	23	22	22	23	22	22
Pectoral rays	13	13	13	13	13	13
Ventral rays	1, 5	1, 5	1, 5	1, 5		1, 5

19. *Tylosurus caribbæus*.

Belone caribbæa Le Sueur, Jour. Acad. Nat. Sci. Phila., ii, 1821, 127 (Caribbean Sea); Cuvier & Valenciennes, xviii, 1846, 430 (Martinique; St. Bartholomew).

Belone altipinna, Poey, Memorias, 293, 1861 (Cuba): Poey, Syn., 381, 1868; Poey, Enumeratio, 120, 1875.

Habitat.—West Indian Fauna; Cuba.

We know this species only from the specimens from Martinique in the museum at Paris, described by Valenciennes. It is very close to *T. acus*, and may be the same, but the upper jaw is somewhat arched at base and the eye is very large ($2\frac{1}{10}$ in postorbital part of head). Poey's *B. altipinna* is doubtless identical with these specimens, and the original *caribbæa* of Le Sueur is presumably the same.

20. *Tylosurus hians*.

Belone hians Cuvier & Valenciennes, xviii, 432, 1846 (Havana, Bahia); Günther, vi, 1866, 248 (West Indies, Bahia); Steindachner, Ichth. Beitr., iii, 64, 1875 (Acapulco); Goode, Proc. U. S. Nat. Mus., 1879 (Florida).

Tylosurus hians Jordan & Gilbert, Synopsis, 1883, 373, 901; Jordan, Proc. U. S. Nat. Mus., 1885, 370; Jordan, l. c. (Havana); Jordan, Cat. Fish. N. A., 1885, 59.

Belone maculata Poey, Memorias, ii, 290, 1861 (Havana); Cope, Trans. Am. Philos. Soc., 1871, 481 (St. Kitts).

Habitat.—West Indies ranging to Brazil, and occasionally northward. Also recorded from the Pacific coast at Acapulco.

Head, 4; depth at pectoral in head, 4; breadth, 9 in head; depth, a little more than postorbital part of head; breadth, 2 in same. D. I, 25; A. I, 26; lat. l. about 520; 430 scales before dorsal. Length, 956 l. U. from Havana, 32 inches.

Body strongly compressed, deepest above ventrals, where it is more

than twice as deep as broad; caudal peduncle not compressed, without keel, the lateral line not conspicuous and not black.

Jaws long and very slender, upper jaw with a peculiar arch at base, so that for a distance about equal to length of eye the two jaws do not come in contact. In this region only small teeth are present in either jaw. In front of this open space the teeth in both jaws are rather large, but smaller than in most of the species. Anteriorly they become again quite small, and toward the front of the jaw only minute teeth are present. Above the open space in jaw the upper surface of the jaw is very convex, both transversely and longitudinally; anteriorly the jaw is much depressed, with a median groove; snout, $5\frac{3}{4}$ in length of body, twice length of rest of head, maxillary entirely concealed by the pre-orbital.

Top of head with a broad shallow median groove, covered with transparent skin and anteriorly scaly. Superciliary bones not prominent, the bones with longitudinal striæ; vertex depressed, not scaly.

Eye large, $1\frac{1}{5}$ in interorbital space; in head, $9\frac{1}{2}$; $2\frac{1}{2}$ in postorbital part of head, 7 in snout.

Cheeks and preopercle rather closely scaled except below. Opercle naked, covered with smooth silvery skin. A little fold of skin like a mucous tube across lower anterior part of preopercle; this less conspicuous than in *T. raphidoma*.

Scales very small, green. Teeth and bones more or less green. No gill-rakers.

Dorsal fin falcate, the anterior lobe $3\frac{1}{4}$ in head; the last rays also more or less elevated, especially in the young, the longest of these rays in adult $5\frac{3}{4}$ in head. Anal higher than dorsal, and beginning further forward; the posterior rays not at all elevated. Pectorals long, falcate, $3\frac{3}{5}$ in head. Ventrals $4\frac{2}{3}$ in head, their insertion midway between base of middle rays of caudal and front of arch of upper jaw. Caudal deeply forked, the lower lobe $2\frac{2}{3}$ in head: the upper, 3.

Color in spirits deep green above, sides bright silvery (young with a series of round dark blotches). A dusky bar on front of opercle; fins all dusky; the tips of the rays black, especially the pectorals, ventrals, and lobes of dorsal and anal.

Our specimens of this species are from Cuba and from Beaufort, North Carolina. No real doubt is connected with the synonymy of this species. The insertion of the ventrals is incorrectly given by Valenciennes as "a little before the middle of the total length." This mistake or ambiguity of expression is corrected by Poey, who however gives a new name, *maculata*, to the Cuban species. We regard *maculata* as without question identical with *hians*.

Steindachner identifies with *T. hians* specimens obtained by him at Acapulco. If this identification be correct, this is the only species of the group common to the two coasts of America.

The *Belone hians* is so remarkably different in the form of the body from the other species of *Tylosurus*, that it may be regarded as forming

a distinct subgenus or possibly genus. For this group the name *Athlennes** has been given. But one species is known. Its characters are given in contrast with those of the species of *Tylosurus* in our analysis of the latter.

Genus III. POTAMORRHAPHIS.

POTAMORRHAPHIS Günther, vi, 1866, 256 (*taniata*).

This genus is well distinguished from the others in the family by the form of its dorsal and caudal fins. Its single known species inhabits the fresh waters of Brazil and Guiana.

ANALYSIS OF SPECIES OF POTAMORRHAPHIS.

- a. Dorsal rays 30 to 34; anal rays 25 to 30; lat. l. 180; trunk tetraëdral, as broad as deep; tail long, strongly compressed, without keel; beak broad, strongly depressed, the lower jaw broader and longer than upper; teeth small; eye small, $2\frac{1}{2}$ in postorbital part of head; maxillary half hidden; ventrals far back, inserted midway between base of pectoral and caudal; anterior rays of dorsal very low, those of anal considerably elevated. A dusky lateral band on sides.

GUIANENSIS, 21.

21. Potamorrhaphis guianensis.

Belone guianensis "Schomburgk, Fish, Guiana, 1841, ii, pl. 1, 131" (Guiana; name only?).

Tylosurus guianensis Müller & Troschel, "Schomburgk, Reise Brit. Guiana, iii, 626, 1843" (Guiana).

Belone scolopacina Cuv. & Val., xviii, 428, 1846 (Rio de la Mana, Cayenne); Günther, vi, 256 (copied).

Belone taniata Günther, vi, 256, 1866 (Rio Capin, Brazil).

Potamorrhaphis taniata Steindachner, Ichth. Beitr., iii, 68, 1875 (Amazon River at Tefié, Villa Bella, Porto do Moz, Santarem, Gurupa, Hyavary River, Lake Manacapurn, etc.).

Habitat.—Rivers of Guiana and Brazil.

Head $2\frac{3}{4}$; depth 8 in head; breadth at pectoral $8\frac{1}{3}$; D. 34; A. 30; Lat. l. about 174; scales before dorsal 108; length (specimens from Itaitubá) $8\frac{1}{2}$ inches.

Body slender, subquadrate in section, broad anteriorly; tail long and slender, much compressed, the lateral line not forming a keel and not black.

Jaws very long and slender, the lower much broader than the upper and somewhat longer; length of upper jaw from eye $3\frac{2}{3}$ times in length of body and $2\frac{1}{2}$ times length of rest of head. Mouth closing completely. Eye small, its diameter $1\frac{1}{5}$ in interorbital space, $2\frac{1}{3}$ in postorbital part of head and 10 in snout. Teeth very small and slender (in comparison with those of most species of *Tylosurus*). Teeth, bones, and scales apparently not green; maxillary not nearly covered by the preorbital.

Interorbital space with a deep naked channel, on each side of which is a slight ridge; vertex somewhat convex; superciliary ridge rather sharp; bones of head little striate; no distinct fold of skin across edge of preopercle; cheek entirely scaled, its scales moderate in size, scales on body comparatively large.

* *Ἀθλεννίς*, "without mucosity," an epithet applied by early authors to their *βελονή* or *Acus*, according to Valenciennes.

No gill-rakers.

Dorsal fin long and low, not at all falcate, its rays gradually and slowly shortened from the first; first dorsal ray 2 in postorbital part of head. Anal fin falcate, its insertion a little behind that of dorsal, its lobe $1\frac{1}{5}$ in postorbital part of head.

Caudal fin pointed, its length $1\frac{1}{6}$ times postorbital part of head. Ventral inserted far back, midway between base of caudal and base of pectoral.

Pectoral very narrow and pointed as long as postorbital part of head.

Color in our specimens entirely faded; the middle of sides apparently with a darker lateral shade.

Our specimens of this species are from Itaituba, in Brazil. According to Dr. Steindachner, it is very abundant in the Amazon River.

Steindachner says that the "oldest name for this species is that of *Belone? guianensis* Schomburgk; since, however, no description is given in Schomburgk's work, that proposed by Dr. Günther may be retained." We have not examined either Schomburgk's work or that of Müller & Troschel, but it is presumable that either the one or the other contains description enough to justify the use of Schomburgk's name, in preference to the later one of Valenciennes. We have examined the types of *Belone scolopacina* in the museum at Paris. They belong to the species here described. The very bad condition of the specimens led Valenciennes to make a gross miscount of the fin-rays ("D. 14; A. 17").

RECAPITULATION.

We here repeat the list of the species of American and European *Belonidæ* recognized by us, with an indication of their geographical distribution: C. (California); P. (Panama fauna); E. (Europe); W. (West Indies); R. (Rivers of Brazil); U. (Atlantic Coast of the United States).

Genus 1. BELONE Cuvier.

1. *Belone belone* L. E. (Perhaps two or three species included in the synonymy.)

Genus 2. TYLOSURUS Cocco.

§ *Tylosurus*.

2. *Tylosurus notatus* Poey. W. U.
3. *Tylosurus scapularis* Jordan & Gilbert. P.
4. *Tylosurus subtruncatus* Poey. W. U. (Synonymy somewhat doubtful; perhaps should be called *brasiliensis*.)
5. *Tylosurus euryops* Bean & Dresel. W.
6. *Tylosurus diplotania* Cope. W. (Species unknown to us.)
7. *Tylosurus microps* Günther. R.
8. *Tylosurus amazonicus* Steindachner. R. (Perhaps identical with *T. microps*.)
9. *Tylosurus ardeolus* Cuv. & Val. W. (Species doubtful as to name and synonymy; unknown to us.)
10. *Tylosurus stolzmanni* Steindachner. P.
11. *Tylosurus exilis* Girard. C.
12. *Tylosurus marinus* Bloch & Schneider. U.
13. *Tylosurus almeida* Quoy & Gaimard. W. (Perhaps to be called *T. brasiliensis*; probably a variety of *T. marinus*.)

14. *Tylosurus fodiator* Jordan & Gilbert. P.
 15. *Tylosurus raphidoma* Ranzani. W. U. (Some of the synonymy uncertain.)
 16. *Tylosurus galeatus* Cuv. & Val. W. (Species unknown to us.)
 17. *Tylosurus pacificus* Steindachner. P.
 18. *Tylosurus acus* Lacépède. W. U. E.? (Perhaps two or three species (*acus*, *imperialis*, *longimanus*) included in the synonymy.)
 19. *Tylosurus caribbaeus* Le Sueur. W. (Some of the synonymy doubtful.)

§ *Athlennes* Jordan & Fordice.

20. *Tylosurus hians* Cuv. & Val. W. U. P.

Genus 3. POTAMORRHAPHIS Günther.

21. *Potamorrhaphis guianensis* Schomburgk. R. (Perhaps to be called *P. scolopacina*.)

List of nominal species, with identifications.

[Tenable specific names are in italics.]

List of nominal species.	Date.	Identification.
<i>Esox belone</i> , Linnæus	1758	<i>Belone belone</i> .
<i>Esox brasiliensis</i> , Linnæus	1758	{ <i>Hemirhamphus balao</i> . ? <i>Tylosurus almeida</i> .
<i>Esox belone</i> var. <i>marinus</i> , Bloch & Schneider	1801	<i>Tylosurus marinus</i> .
<i>Sphyræna acus</i> , Lacépède	1803	<i>Tylosurus acus</i> .
<i>Esox imperialis</i> , Rafinesque	1810	<i>Tylosurus</i> (<i>acus</i> ?) <i>imperialis</i> .
<i>Esox longirostris</i> , Mitchell	1818	<i>Tyl. marinus</i> .
<i>Belone caribbaea</i> , Le Sueur	1821	<i>Tyl. caribbaeus</i> .
<i>Belone almeida</i> , Quoy & Gaimard	1825	<i>Tyl. almeida</i> .
<i>Belone acus</i> , Risso	1826	<i>Belone belone</i> .
<i>Belone vulgaris</i> , Fleming	1828	<i>Belone belone</i> .
<i>Belone rostrata</i> , Faber	1829	<i>Belone belone</i> .
<i>Tylosurus cantrainii</i> , Cocco	1829	<i>Tyl. (acus?) imperialis</i> .
<i>Hemirhamphus europæus</i> , Yarrell	1837	<i>Belone belone</i> .
<i>Belone guianensis</i> , Schomburgk	1841	<i>Potamorrhaphis guianensis</i> .
<i>Belone raphidoma</i> , Ranzani	1842	<i>Tyl. raphidoma</i> .
<i>Belone ardeola</i> , Cuv. & Val	1846	<i>Tyl. ardeolus</i> .
<i>Belone timucu</i> , Cuv. & Val	1846	<i>Tyl. almeida</i> .
<i>Belone scolopacina</i> , Cuv. & Val	1846	<i>Potam. guianensis</i> .
<i>Belone galeata</i> , Cuv. & Val	1846	<i>Tyl. galeatus</i> .
<i>Belone hians</i> , Cuv. & Val	1846	<i>Tyl. hians</i> .
<i>Belone cigonella</i> , Cuv. & Val	1846	<i>Tyl. ardeolus</i> ?
<i>Belone gerania</i> , Cuv. & Val	1846	<i>Tyl. raphidoma</i> .
<i>Belone argalus</i> , Le Sueur	1846	<i>Tyl. ardeolus</i> ?
<i>Macrognaathus scolopax</i> , Gronow	1854	<i>Belone belone</i> .
<i>Belone exilis</i> , Girard	1854	<i>Tyl. exilis</i> .
<i>Belone scrutator</i> , Girard	1859	<i>Tyl. marinus</i> .
<i>Hemirhamphus obtusus</i> , Couch	1860	<i>Belone belone</i> .
<i>Belone maculata</i> , Poey	1861	<i>Tyl. hians</i> .
<i>Belone crassa</i> , Poey	1861	<i>Tyl. raphidoma</i> .
<i>Belone latimana</i> , Poey	1861	<i>Tyl. acus</i> .
<i>Belone altipinna</i> , Poey	1861	<i>Tyl. caribbaeus</i> .
<i>Belone notata</i> , Poey	1861	<i>Tyl. notatus</i> .
<i>Belone melanochira</i> , Poey	1861	<i>Tyl. raphidoma</i> .
<i>Belone subtruncata</i> , Poey	1861	<i>Tyl. subtruncatus</i> .
<i>Belone depressa</i> , Poey	1861	<i>Tyl. subtruncatus</i> .
<i>Belone linnæi</i> , Malm.	1866	<i>Belone belone</i> .
<i>Belone microps</i> , Günther	1866	<i>Tyl. microps</i> .
<i>Belone gracilis</i> , Günther	1866	<i>Belone (belone) gracilis</i> .
<i>Belone euxini</i> , Günther	1866	<i>Belone (belone) euxini</i> .
<i>Belone cornidii</i> , Günther	1866	<i>Belone (belone) cornidii</i> .
<i>Belone tenuata</i> , Günther	1866	<i>Potam. guianensis</i> .
<i>Belone diplotenia</i> , Cope	1871	<i>Tyl. diplotenia</i> .
<i>Belone pacifica</i> , Steindachner	1875	<i>Tyl. pacificus</i> .
<i>Belone amazonica</i> , Steindachner	1875	<i>Tyl. (microps) amazonicus</i> .
<i>Belone jonesi</i> , Goode	1877	<i>Tyl. acus</i> .
<i>Belone stolzmanni</i> , Steindachner	1878	<i>Tyl. stolzmanni</i> .
<i>Belone jonesi</i> , Günther	1879	<i>Tyl. acus</i> .
<i>Tylosurus sierrita</i> , Jordan & Gilbert	1881	<i>Tyl. stolzmanni</i> .
<i>Tylosurus fodiator</i> , Jordan & Gilbert	1881	<i>Tyl. fodiator</i> .
<i>Tylosurus scapularis</i> , Jordan & Gilbert	1881	<i>Tyl. scapularis</i> .
<i>Tylosurus gladius</i> , Bean	1882	<i>Tyl. raphidoma</i> .
<i>Tylosurus sagitta</i> , Jordan & Gilbert	1884	<i>Tyl. subtruncatus</i> .
<i>Tylosurus euryops</i> , Bean & Dresel	1884	<i>Tyl. euryops</i> .